

# Genetics problems

You need to work these problems on lined paper.

Make sure that you show all of your work.

1. In a certain plant, when individuals with blue flowers are crossed with individuals with blue flowers, only blue flowers are produced. Plants with red flowers crossed with plants with red flowers sometimes produce only red flowers, although other times *they* produce either red or blue flowers. When plants with red flowers are crossed with plants with blue flower sometimes only red flowers are produced, other times either red or blue flowers are produced. Which gene is dominant?
2. Tall (D) is dominant to dwarf (d). Give the  $F_2$  genotypic and phenotypic ratios of a cross between a pure-breeding tall plant and a pure-breeding dwarf plant.
3. If wire hair (W) is dominant to smooth hair (w) and you find a wire-haired puppy, how would you determine its genotype by a genetic breeding experiment? Give both the genotype and phenotype involved with the cross with the unknown.
4. In poultry, rose comb is controlled by a dominant allele and the recessive allele controls single comb.
  - (a) Give the genotype and phenotype produced from crossings pure-breeding rose comb chicken with a pure-breeding single comb chicken.
  - (b) Give the results of the backcross of the  $F_1$  hybrid with both pure-breeding parents.
5. If black fur color is controlled by a dominant allele (B) and brown by its recessive allele (b), give the genotypes of the parents and offspring of a cross of a black male with a brown female that produces  $1/2$  black offspring and  $1/2$  brown offspring.
6. If 2 spot (S) is dominant to 4 spot (s), give the genotypes for the parents in the following crosses;
  - (a) 2 spot x 2 spot yields 2 spot and 4 spot
  - (b) 2 spot x 4 spot yields only 2 spot
  - (c) 2 spot x 4 spot yields 2 spot and 4 spot
  - (d) 2 spot x 2 spot yields only 2 spot
  - (e) 4 spot x 4 spot yields only 4 spot
7. In humans, normal skin pigmentation is influenced by a dominant gene (C) which allows pigmentation to develop. All individuals who are homozygous for the recessive allele (c) are unable to produce an enzyme needed for melanin formation and are therefore referred to as albino. Two normal parents produce an albino child. What are the chances that the next child will be an albino?

8. In garden peas, one pair of alleles controls the height of the plant and a second pair of alleles controls flower color. The allele for tall (D) is dominant to the allele for dwarf (d), and the allele for purple (P) is dominant to the allele for white (p). A tall plant with purple flowers crossed with a dwarf plant with white flowers produces 1/2 tall with purple flowers and 1/2 tall with white flower. What is the genotype of the parents?
9. In garden peas, one pair of alleles controls the height of the plant and a second pair of alleles, controls flower color. The allele for tall (D) is dominant to the allele for dwarf (d), and the allele for purple (P) is dominant to the allele for white (p). A tall plant with white flowers crossed with a dwarf plant with purple flowers produces all Tall off spring with purple flowers. What is the genotype of the parents?
10. In garden peas, one pair of alleles controls the height of the plant and a second pair of alleles controls flower color. The allele for tall (D) is dominant to the allele for dwarf (d), and the allele for purple (P) is dominant to the allele for white (p). A tall plant with purple flowers crossed with a dwarf plant with white flowers produces 1/4 tall purple, 1/4 tall white, 1/4 dwarf purple, and 1/4 dwarf white. What is the genotype of the parents?
11. In garden peas, one pair of alleles controls the height of the plant and a second pair of alleles; controls flower color. The allele for tall (D) is dominant to the allele for dwarf (d), and the allele for purple (P) is dominant to the allele for white (p). A tall plant with white flowers crossed with a dwarf plant with purple flowers produces 1/4 tall purple, 1/4 tall white, 1/4 dwarf purple, and 1/4 dwarf white. What is the genotype of the parents?
12. In garden peas, one pair of alleles controls the height of the plant and a second pair of alleles controls flower color, the allele for tall (D) is dominant to the allele for dwarf (d), and the allele for purple (P) is dominant to the allele for white (p). A tall plant with purple flowers crossed with a tall plant with white flowers produces 3/8 tall purple, 1/4 tall white, 3/4 dwarf purple, and 1/4 dwarf white. What is the genotype of the parents?
13. In garden pea, one pair of alleles controls the height of the plant and a second pair of alleles controls flower color. The allele for tall (D) is dominant to the allele for dwarf (d), and the allele for purple (P) is dominant to the allele for white: (p). A tall purple crossed with a tall purple produces 3/4 tall purple and 1/4 tall white. What is the genotype of the parents?
14. In horses, black coat color is influenced by the dominant allele (B), and chestnut coat color is influenced by the recessive allele (b). Trotting gait is due to a dominant gene (T), pacing gait to the recessive allele (t). If a homozygous black Trotter is crossed to a chestnut pacer,
- what will be the appearance of the F<sub>1</sub> and F<sub>2</sub> generations?
  - which phenotype will be the most common?
  - which genotype will be the most common?
  - which of the potential off spring will be certain to breed true?

15. In horses, black coat color is influenced by the dominant allele (B), and chestnut coat color is influenced by the recessive allele (b). Trotting gait is due to a dominant gene (T), pacing gait to the recessive allele (t). What color horse would you use to find out the genotype of a black trotter? Give the genotype and phenotype.
16. Crosses between a yellow rat with a yellow rat always produce yellow. Crosses between a white rat with a white rat always produce white. The alleles affect the same aspect of coat color. The crosses of a white with a yellow produce a cream. What happens if you cross two creams?
17. If long or round are homozygous forms of an incompletely dominant gene and oval is the phenotype of the heterozygote, give the  $F_2$  ratio of the cross between long and round (both genotype and phenotype).
18. In radishes, two incompletely dominant genes control color and shape. Red and white radishes are homozygous, whereas the hybrid is purple. Long and round are homozygous and, if crossed, will produce an oval hybrid. Give the  $F_1$  genotypic and phenotypic ratio produced by crossing pure-breed red long radishes with white round varieties.
19. In a certain breed of chicken an incompletely dominant gene controls color. The homozygous black, when crossed with the homozygous splashed-white, produces an intermediate gray color pattern referred to as blue. A second gene controls the shape of the comb. The dominant allele (R) produces rose, whereas the recessive allele (r) produces single. Give the  $F_1$  and  $F_2$  genotypic and phenotypic ratios of a cross between a pure breeding black single and a pure breeding splash-white rose.
20. There are three alleles controlling the ABO blood types.  $I^A$  and  $I^B$  are codominant genes so that the combination  $I^A I^B$  produces the AB blood type. The third allele  $i$  is recessive to the other two alleles. Indicate which of these parents could produce the given child:

Parents	Child	Yes or No
a. A x AB	B	
b. A x O	A	
c. A x B	O	
d. A x AB	O	
e. A x AB	B	
f. B x B	O	
g. AB x AB	A	

21. In cats an X-linked pair of alleles, B and b control color of fur. The alleles are incompletely dominant: B produces black, b produces yellow, and Bb produces tortoise-shell.
- A yellow cat had a litter of two tortoise-shell and one yellow kittens. What is the sex of the yellow kitten?
  - A tortoise-shell cat brings home a litter of black, yellow, and tortoise-shell kittens. The color of which sex would tell you the color of the tomcat that produced them?
  - A yellow male is crossed with a tortoise-shell female. If the female has all male kittens in her litter of four. What color(s) would they be?
  - A tortoise-shell cat brings home her litter of black, yellow, and tortoise-shell kittens- By what method could you possibly decide whether the male parent was the black tomcat next door?
22. If a father and a son are both color blind and the mother is normal, is it likely that the son inherited color blindness from his father?
23. If the gene for yellow body color ( y ) is an X-linked recessive and its dominant counterpart (Y) produces wild body colors, give the phenotypes expected and their frequencies for the following four crosses:
- yellow female x wild male
  - wild carrier female x wild male
  - wild carrier female x yellow male
  - homozygous wild female x yellow male
24. Two *Drosophila* are crossed several times, with a total number of offspring of 106 females and 48 males. There is too great a deviation from the expected 1:1 ratio for chance alone to account for the difference. What other factor could account for this difference?
25. White eyes in *Drosophila* is a mutation that turned out to be an X-linked recessive. Would you expect that the first time the white eye was discovered it was in a male or a female?
26. Hemophilia is an X-linked recessive gene. A normal woman whose father had hemophilia marries a normal man. What are the chances of hemophilia in their children?
27. Colorblindness is an X-linked recessive gene. Two normal-visioned parents produce a color-blind child.
- Is this child male or female?
  - What are the genotypes of the parents?
  - What are the chances that their next child will be a color-blind daughter?

28. Red-green color blindness is an X-linked recessive trait. Two normal-visioned parents have a color-blind son. Indicate the genotype and phenotype of each parent and the son.
29. There is an autosomal gene that controls baldness; and its expression is sex-influenced, so that the gene for baldness (B) is dominant in males, but recessive in females. In females the allele B1 for nonbaldness is dominant over the gene for baldness. If a heterozygous nonbald woman marries a nonbald man, what will be the appearance of their children? Work out the possibilities for each sex.
30. Short index fingers (shorter than ring finger) are dominant in males and recessive in females, whereas long index fingers (as long as or longer than the ring fingers) are dominant in females and recessive in males. Give the F<sub>2</sub> genotype and phenotype resulting from the cross of a male with long index fingers with a female with short index fingers